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(71) Applicant(s)
Landis & Gyr (UK) Ltd

(Incorporated in the United Kingdom)

Hortonwood 30, TELFORD, Shropshire, TF1 4ET, United Kingdom

(72) Inventor(s)
Martin Robert Pollock

(74) Agent and/or Address for Service
D Young & Co
21 New Fetter Lane, LONDON, EC4A 1DA, United Kingdom

(54) Metering systems

(57) Metering apparatus 1 comprises means 8 for metering the supply of a service to a consumer, an indicator 2 for indicating the meter reading, valve or switch means 11 for selectively enabling and disabling the supply of the service to the consumer, input means 4 for input by the consumer of a code comprising a coded meter reading, and
control means 9 for decoding the meter reading from the input code and controlling operation of the valve or switch means 11 in dependence on whether the decoded meter reading is within a predetermined tolerance of the current meter reading of the apparatus. The code to be input may be notified to the consumer by telephone from a central control station, and may include ID data identifying a particular meter.

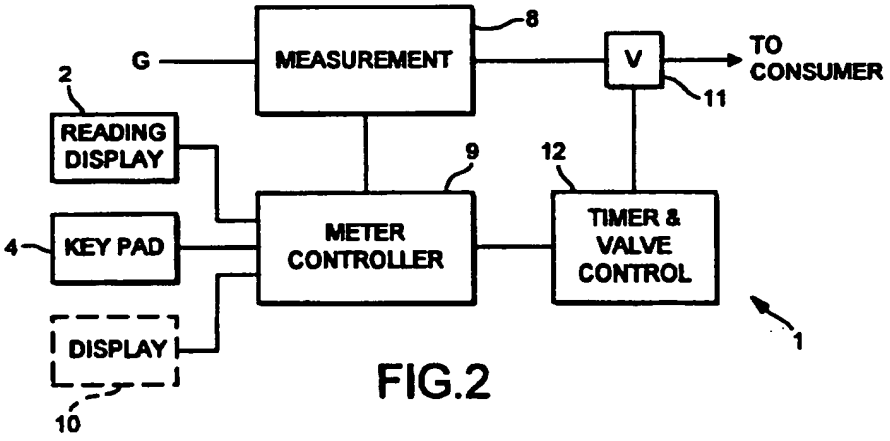

FIG.2

GB 2 312 069 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

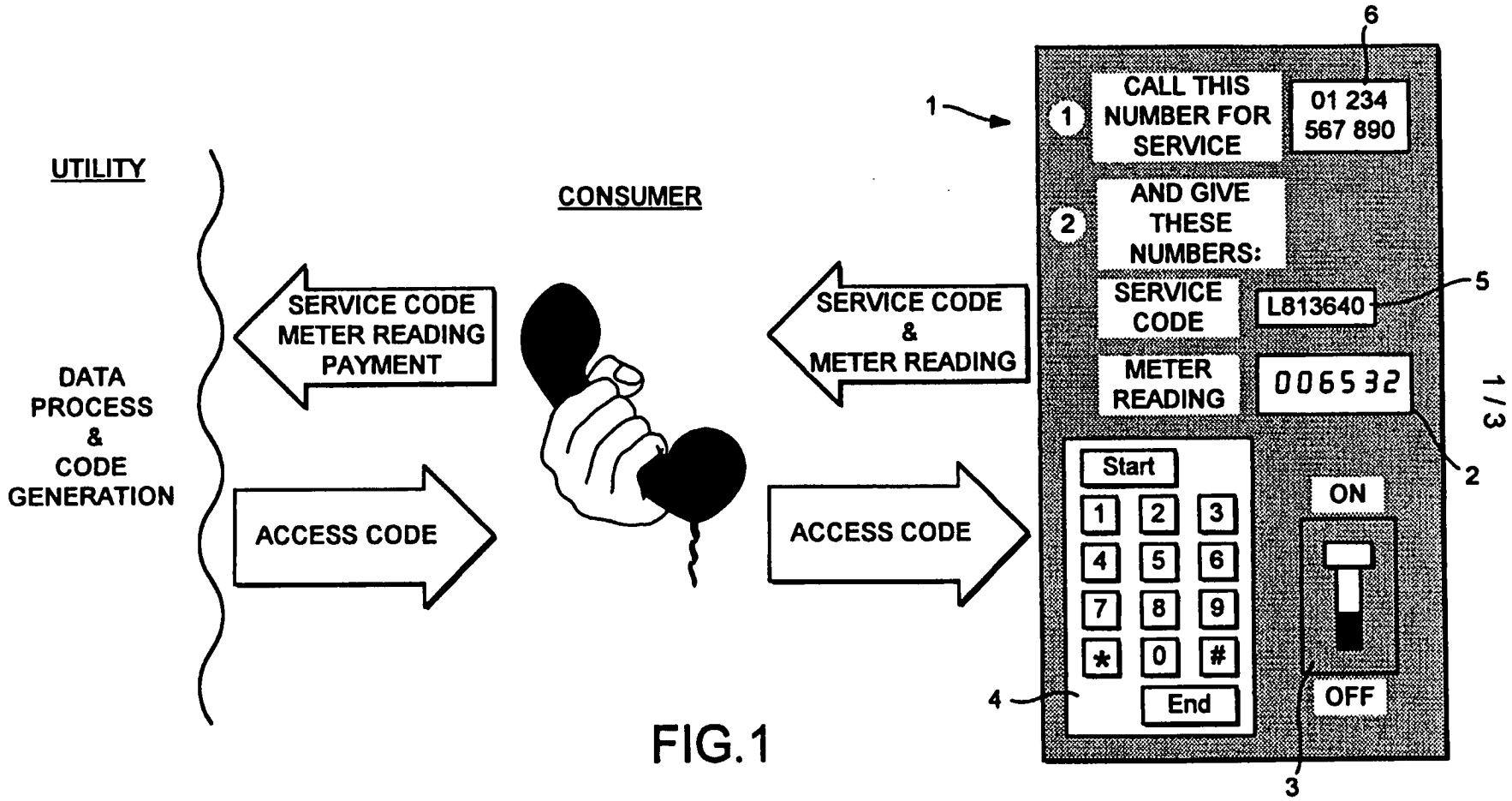
UTILITY
CONSUMER
DATA PROCESS & CODE GENERATION
SERVICE CODE METER READING PAYMENT
ACCESS CODE
SERVICE CODE & METER READING
ACCESS CODE
1
CALL THIS NUMBER FOR SERVICE
01 234 567 890
AND GIVE THESE NUMBERS:
SERVICE CODE
L813640
METER READING
006532
Start
1 2 3
4 5 6
7 8 9
* 0 #
End
ON
OFF
1
2
3
4
5
6

FIG.1

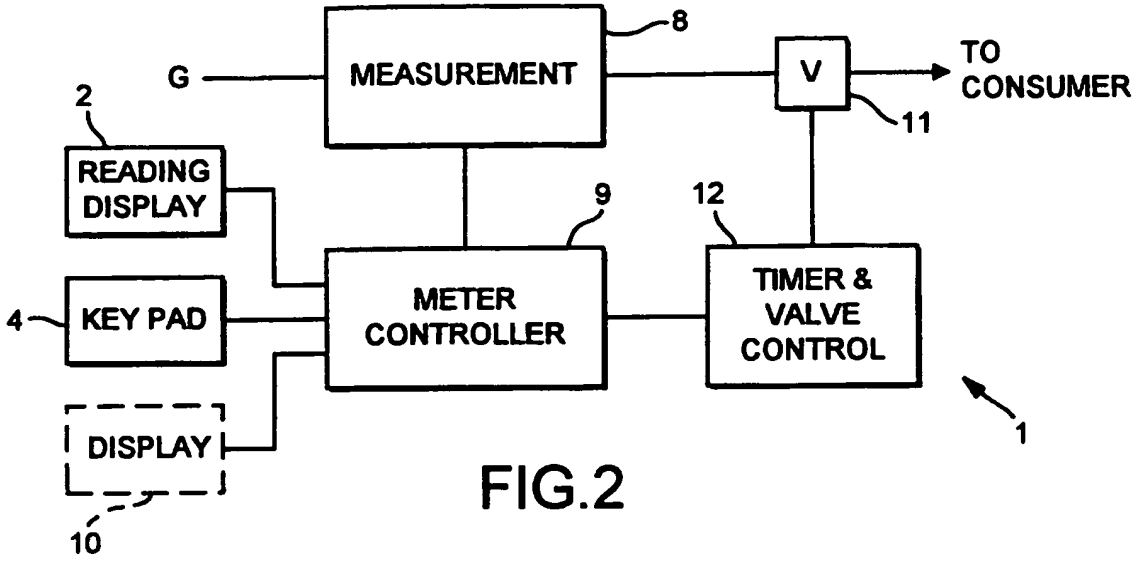
G
MEASUREMENT
8
V
TO CONSUMER
11
2
READING DISPLAY
9
12
4
KEY PAD
METER CONTROLLER
TIMER & VALVE CONTROL
1
DISPLAY
10

FIG.2

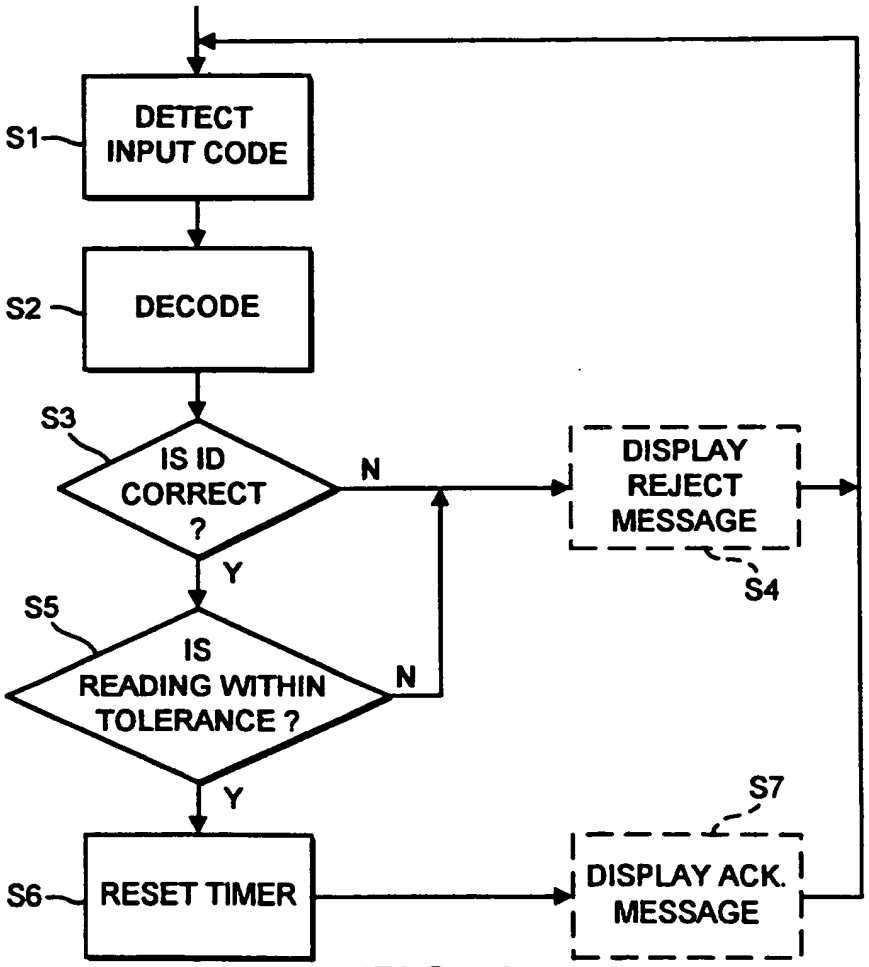
S1
DETECT INPUT CODE
S2
DECODE
S3
IS ID CORRECT ?
N
DISPLAY REJECT MESSAGE
S4
Y
S5
IS READING WITHIN TOLERANCE ?
N
Y
S7
S6
RESET TIMER
DISPLAY ACK. MESSAGE

FIG. 3

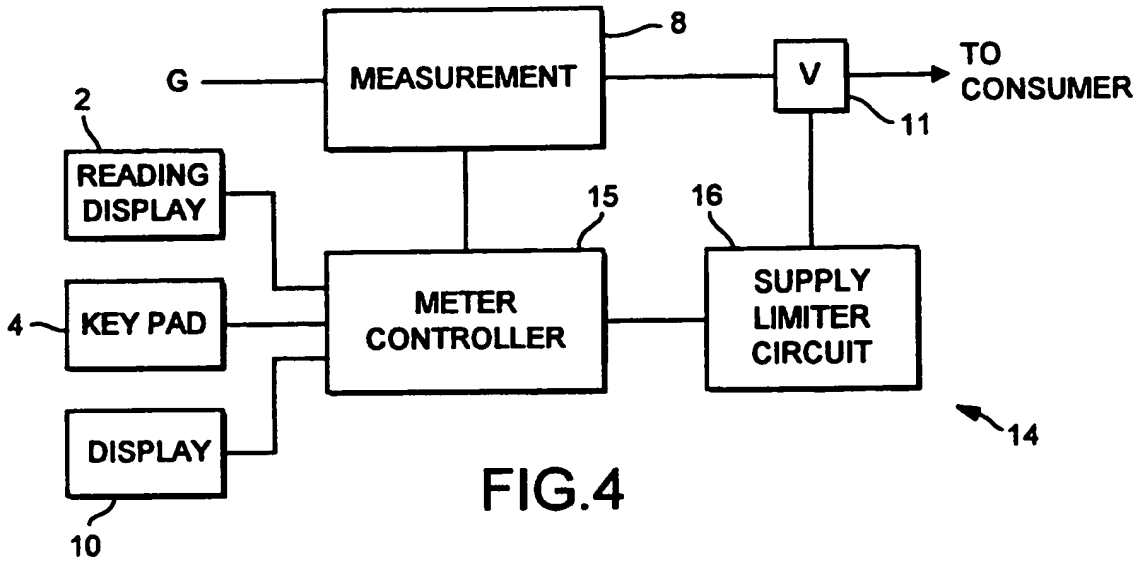
G
MEASUREMENT
8
V
TO CONSUMER
11
2
READING DISPLAY
15
16
4
KEY PAD
METER CONTROLLER
SUPPLY LIMITER CIRCUIT
DISPLAY
14
10

FIG.4

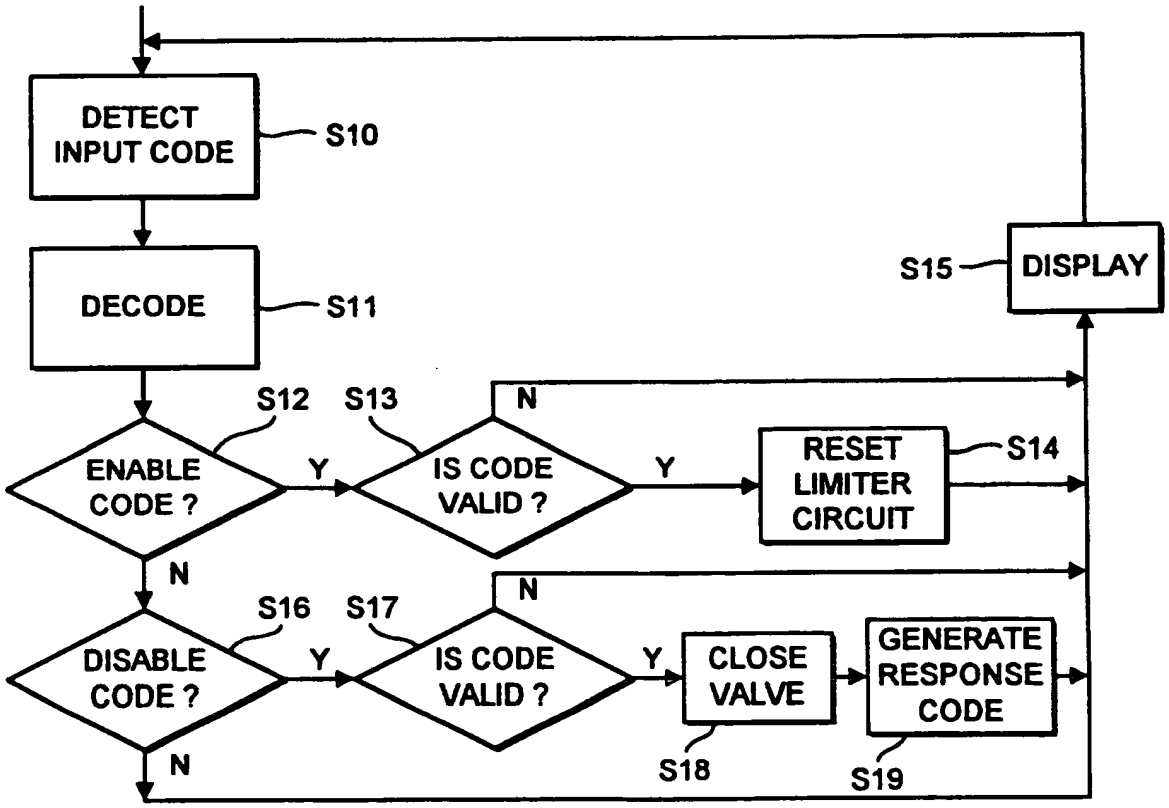
DETECT INPUT CODE
S10
DECODE
S11
S15
DISPLAY
S12
S13
N
ENABLE CODE ?
Y
IS CODE VALID ?
Y
RESET LIMITER CIRCUIT
S14
N
S16
S17
N
DISABLE CODE ?
Y
IS CODE VALID ?
Y
CLOSE VALVE
GENERATE RESPONSE CODE
N
S18
S19

FIG. 5

METERING SYSTEMS

This invention relates generally to metering systems for metering the supply of a service, such as gas, electricity, water etc., to a consumer. The following description will focus on gas meter systems, but it is to be understood that the invention can be applied to metering of other services.

As is well known, gas meters are used to meter the supply of gas to a consumer so that payment can be obtained in accordance with consumption. Some gas meter installations are provided with a prepayment facility whereby a consumer can load the meter with credit, for example by inserting coins or tokens. Such prepayment meters incorporate a valve which can be operated by the meter control circuitry to cut off the gas supply to the consumer when the credit has expired. Here, therefore, the consumer pays in advance for consumption of gas. More commonly, however, there is no prepayment facility, and the Utility company obtains payment by reading the meter periodically and billing the consumer for consumption. The meter must also be read to open a new account when a new customer takes over at a premises, or to close an account when a customer leaves a premises. The Utility must therefore gain access to the consumer's premises at appropriate times to read the meter. This can be inconvenient to individual consumers and requires a substantial workforce investment by Utility companies who need to bill numerous customers on the basis of accurate meter reading information from distributed metering points.

According to one aspect of the present invention there is provided metering apparatus comprising:

means for metering the supply of a service to a consumer;

an indicator for indicating the meter reading;

valve means for selectively enabling and disabling the supply of the service to the consumer;

input means for input by the consumer of a code comprising a coded meter reading; and

control means for decoding the meter reading from an input code and controlling operation of the valve means in dependence on whether the decoded meter reading is within a predetermined tolerance of the current meter reading of the apparatus.

In embodiments of the present invention, therefore, the valve means is operable to enable and disable the supply under control of the control means. The valve means may comprise any suitable means for performing the necessary function, for example a gas valve in the case of a gas metering apparatus, or a switch in the case of an electricity metering apparatus. In order to activate the control means to control operation of the valve means, the consumer must input a code via the input means of the apparatus. This code will be issued to the consumer by the Utility when the consumer supplies certain information, comprising at least the current meter reading, and, where appropriate, effects payment for the service. The code issued by the Utility is generated from at least the meter reading supplied by the consumer. This code, comprising the coded meter reading, is received by the control means when input to the metering apparatus by the consumer. The control means decodes the meter reading from the input code and determines whether the decoded meter reading corresponds to the current meter reading of the apparatus. That is to say, the control means determines whether the decoded meter reading is within a predetermined tolerance of the current meter reading. (The tolerance may be set as appropriate for a given situation, but may for example be ± 10 kWh (kilowatt.hours)). If the decoded meter reading does not satisfy this condition, then the code is invalid and the control means will not act on the code. If the decoded meter reading does satisfy the necessary condition (and if the input code meets any further requirements for which the control means may test as is the case in some embodiments to be discussed below), then the control means determines the code to be valid and performs the required control operation.

Thus, it will be understood that in order to activate the control means to control operation of the valve means, the consumer must give the correct meter reading to the service provider since this will be used to generate the code which is subsequently decoded and checked by the metering apparatus. If an incorrect meter reading is given, whether intentionally or otherwise, the control means will not act on the code. This system can be used to ensure that the service provider obtains accurate meter readings, under various circumstances in which these are required, without having to attend the premises to read the meter. For example, in some embodiments the system can be used to

enable supply of the service when a new customer takes over at a premises where the supply is cut-off. In this case, the customer can read the meter himself and supply the necessary information, including the meter reading, to the Utility. The Utility then issues the customer with a code generated using this meter reading, and the customer inputs this code to the metering apparatus. The control means decodes and checks the meter reading to determine whether the code is valid, and if so activates the valve means to enable the supply. The supply is therefore restored only if the customer gave the correct meter reading.

In preferred embodiments, the control means includes means for automatically disabling the supply to restrict the quantity of the service that can be supplied to a consumer without payment being made. The restriction can be implemented on a time or quantity of service basis. For example, the control means may include timer means for controlling the valve means to disable the supply on expiry of a preset period of time. To restore the supply, or maintain the supply beyond a cut-off time, the consumer must input a code obtained from the Utility. The code will be issued to the consumer when the consumer supplies certain information, comprising at least the current meter reading, and effects payment for the service. Generally, the consumer will pay for consumption up to that point in time as determined by the meter reading communicated to the Utility. It will be appreciated, however, that the system could be operated on a prepayment basis, whereby the consumer pays for estimated consumption over the next period and any discrepancy between estimated and actual consumption over that period is taken into account at the next payment stage. Thus, a simple form of prepayment system can be implemented. Either way, when the code is input to the metering apparatus, provided the code is valid, the timer means will be reset to restore or maintain the supply for a further period.

Alternatively, or in addition, the control means may be arranged to monitor the quantity of the service supplied to the consumer following receipt of the last valid code which enabled (or maintained) the supply, and to control the valve means to disable the supply when a preset quantity of the service has been supplied. Again, the system could be operated on a prepayment basis if desired. Where both time

and quantity limits are employed, the control means controls the valve to disable the supply on whichever occurs first of expiry of said preset period and supply of said preset quantity. In this way, the service would terminate sooner if very high consumption was being recorded.

With the systems just described, the Utility benefits in that it limits its risk in service supply to the time periods or quantity limits enabled by the code issuing process. These risks are currently open-ended in that consumers can use an unlimited quantity of service if they prevent the Utility from gaining entry to the metering point. The Utility also obtains guaranteed correct metering readings on a regular basis, otherwise the service provision will self-terminate. (Currently customer readings are not accepted by the industry as authentic readings). A further advantage where a time restriction is employed is that metering points will shut themselves down if left unused for very long periods of time, thus improving system safety. The customer also benefits, since customer meter readings can be accepted by the Utility, so the customer need not make special provision to be at home to receive meter readers who may or may not turn-up on time.

The code issuing process can also be employed for termination of service at a metering point eg. when a consumer leaves a premises. To close an account, the Utility needs the final meter reading so that payment can be brought up-to-date. Thus, the customer informs the Utility that he is leaving, supplies the necessary information, comprising at least the current meter reading, and effects the final payment. The Utility again issues the customer with a code comprising the coded meter reading, to be input to the metering apparatus. The control means checks whether the code is valid (by at least checking that the decoded meter reading is within the allowed tolerance of the current reading), and if so controls the valve means to disable the supply. In this case, however, since the customer is not concerned about maintenance of the supply, it is desirable to employ an additional measure to ensure that the customer gives the correct meter reading. Thus, the control means of the metering apparatus preferably includes means for generating a response code on disabling of the supply under these circumstances, the response code being indicated to

the customer, for example on a display of the apparatus. When issuing the original code to the customer, the Utility informs the customer that he must report back the response code generated by the meter to terminate his responsibility for consumption at that metering point. When the response code is reported to the Utility, its authenticity is checked to ensure that the supply has indeed been disabled. The customer's account is then closed. If the response code is not confirmed by the Utility, indicating for example that the meter reading supplied by the customer was not correct and hence that the input code was rejected as invalid, then the customer remains responsible for consumption at that metering point.

Further advantages of the system will be apparent. For example, while a paper based customer-Utility communication system can be employed, where the conclusion of the billing/payment cycle for example is the issue to the customer of a code written on the receipt, other more convenient communication systems can be adopted. In particular, for example, the communication can be conducted by telephone, the customer supplying the necessary information and suitable payment guarantee (eg. credit card details) where necessary and then being told the appropriate code. The necessary operation, such as restoration of a dead supply, can then be performed almost instantly, simply by making a phone call. In this way, the Utility can operate a bill-free system if desired. Further, the Utility/customer communication process can be fully automated at the system end since the only information which need travel in each direction could be limited to short strings of numbers and formal greetings/options. Preferred embodiments of metering systems therefore include an automatic control station comprising: communication means for communicating with a consumer to prompt the consumer to communicate required data including a meter reading; and means for generating a code, comprising the communicated meter reading, for communication to the consumer by said communication means. Preferably the communication means is arranged for communication with the consumer via a telephone link and includes voice output means for generating voice instructions to the consumer. While arrangements may be envisaged where the consumer supplies the necessary information using the telephone keypad, voice communications will generally be more convenient and this can of course be accommodated by a programmed voice

input/output system of the control station. Other communication systems may of course be envisaged, for example a system in which the control station is provided as a terminal in a convenient public location for access by consumers.

As already explained, the code supplied to a consumer comprises a coded meter reading. The code may of course be constructed in numerous ways. For example, the coded meter reading may include the actual meter reading data (ie. the actual digits of the meter reading supplied by the consumer) plus check data which is derived from the meter reading data at the code generation stage by a predetermined algorithm. In this case, although the meter reading itself appears in the code and will be apparent to the consumer, the check data is derived from the meter reading and will be confirmed by the control means when the code is input to the metering apparatus. Thus, the consumer cannot defraud the system by merely altering the meter reading in the code input to the apparatus, since the check data would then be incorrect and the code rejected. Preferably, however, the actual meter reading data is in coded form in an input code, so that the digits forming the meter reading supplied by the consumer do not appear identically in the code.

It is preferred that the code issued to the consumer includes additional data over and above the coded meter reading. In particular, for example, the additional data preferably comprises ID data identifying the metering apparatus. Suitable ID data may be the meter number for example. The consumer will supply the ID data to the Utility with the meter reading, and the code will be generated accordingly. The meter ID will be prestored in the control means of the apparatus and, when the code is input by the consumer, the control means will compare the ID data decoded from the input code with the prestored ID and will reject the code if the ID is incorrect. Here, both the ID data decoded from an input code, and the decoded meter reading, must be correct for the code to be identified as valid. As in the case of the meter reading data, the additional data such as the ID data preferably appears in coded form in the code supplied to the consumer.

The decoding process performed by the control means will usually involve operating on the input code with the reverse algorithm to that

performed in the code generation process. However, in a situation where, for example, the actual meter reading supplied by the consumer appears identically in the code, the decoding merely involves extracting the appropriate portion of the code corresponding to the meter reading, but in this case the extracted reading will need to be verified by confirming that the check data is correct according to the algorithm used in the code generation process. Either way, the decoded meter reading is then compared with the current meter reading to confirm that the reading supplied to the Utility was correct (within the allowed tolerance). Any additional data contained in the code can be similarly processed. Of course, depending on the construction of the code, for at least some of the data the appropriately coded form may be prestored in the control means for comparison with the relevant portion of a code input by the consumer. Alternatively, for at least some of the data, in particular data prestored in the control means, the control means could also implement the coding algorithm to obtain coded data for comparison with a code input by the consumer.

Where the metering apparatus is operable to perform more than one function in dependence on an input code, eg. restoration and/or maintenance of the supply and disabling of the supply on termination of service, the input code may include instruction data indicating the function to be implemented. For example, the instruction data may identify the code as an "enable code" for restoration/maintenance of the supply and as a "disable code" for disabling the supply, eg. on termination of an account. The control means then identifies the nature of the code from the instruction data. Further, where the control means is operative to generate a response code to confirm termination of the service, the response code is preferably generated using a prestored algorithm (which is confidential to the Utility) from data such as the input disable code, meter reading and/or ID data for example, so that the formulation of the code is not apparent to the consumer. The validity of the response code can then be confirmed by the Utility, eg. by comparison with the expected response code generated using the same data and the same algorithm by the Utility.

A further aspect of the invention provides a method of controlling the supply of a metered service to a consumer, the method comprising:

metering the supply by means of metering apparatus including an indicator for indicating the meter reading, valve means for selectively enabling and disabling the supply of the service to the consumer, and input means for input by the consumer of a code comprising a coded meter reading;

decoding the meter reading from an input code in the metering apparatus; and

controlling the valve means in dependence on whether the decoded meter reading is within a predetermined tolerance of the current meter reading of the apparatus. The method may include generating said code at a control station using a meter reading communicated by the consumer, and communicating the code to the consumer for input to the metering apparatus.

In general, it is to be understood that where features are described herein with reference to an apparatus embodying the invention, corresponding features may be provided in accordance with a method of the invention, and vice versa.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram illustrating a first metering system embodying the invention;

Figure 2 is a block diagram of metering apparatus of the system of Figure 1;

Figure 3 is a flow chart illustrating operation of the apparatus of Figure 2;

Figure 4 is a block diagram of a second embodiment of metering apparatus according to the invention; and

Figure 5 is a flow chart illustrating operation of the embodiment of Figure 4.

The schematic of Figure 1 illustrates the overall operation of the metering system of a first embodiment. The figure shows the front panel of a gas meter 1 for metering a supply of gas to a consumer. The meter 1 has the usual meter reading display 2 and on/off switch 3, and also has user operable input means in the form of a keypad 4. The front panel of the meter 1 also indicates the meter number, or service code, at 5 and a telephone number at 6 for the customer service facility of the Utility.

As illustrated by the arrows in the figure, in order to pay for gas consumption, the consumer notes the meter reading from the display 2 and the meter service code 5 and telephones the Utility service facility by dialling the number indicated at 6. The consumer then tells the service facility the service code and meter reading, and authorises the required payment by giving credit card details for example. This information is processed by the Utility as required, and the service code and meter reading are used to generate an access code which is then communicated to the consumer. The access code is a function of the service code (which serves here as ID data identifying the meter) and the meter reading, and the code is produced using an encoding algorithm which is confidential to the Utility.

Although not shown in the figure, the service facility is preferably a fully-automated control station comprising a programmed voice input/output system, of generally known type, for prompting the consumer with voice instructions to communicate the required data, and for detecting the consumers responses. (These can be limited to simple strings of digits and selection of options for example). The communication system can be microprocessor controlled, and the code generator for generating access codes based on data supplied by the consumer can be implemented by the microprocessor as will be apparent to those skilled in the art.

Once the consumer receives the access code, this is input to the meter 1 via the keypad 4. The consumer presses the START key on the keypad to indicate initiation of a code entry process, and then inputs the code using the appropriate numbered keys. Code entry is terminated by pressing the END key on the keypad.

Figure 2 is a schematic block diagram of the meter 1 of Figure 1. The meter 1 includes the usual measurement circuitry 8 for metering the supply of gas G to the consumer. The consumption data is communicated to a microprocessor-based meter controller 9. The meter controller 9 drives the meter reading display 2 to display the current meter reading, and is responsive to the keypad 4 for input of access codes. As indicated by the broken lines in the figure, the meter may include a further display 10 for displaying further information. For example, the display 10 may be used to display the digits entered by the consumer via the keypad 4 to facilitate code entry and also

instructions/messages relating to the code entry process. The display 10 may also display status information, eg to indicate a fault condition or to indicate when further payment will be required to maintain the gas supply.

The meter 1 includes a valve (V) 11 which is connected in the gas supply line to the consumer. For actuation of the valve 11 to disconnect/reconnect the supply, the meter includes a timer & valve control circuit 12 which is also connected to the meter controller 9. When the timer 12 is reset by the meter controller as described further below, the timer transmits a signal to open the valve 11. (If the valve is already open when the timer is reset, the open condition is unaffected by this signal). Once reset, the timer 12 commences the timing operation. After a preset time interval following reset, the timer 12 generates a further control signal to close the valve 11, thus disconnecting the gas supply to the consumer. The time interval here may be set as desired by the Utility (and may be variable after installation as described further below), but as an example the time interval might be set at three months. Thus, after the timer 12 is reset, gas consumption will be permitted for the three month period. If the timer is reset again during that period, the three month interval will begin again from the reset time.

Operation of the apparatus will now be described with reference to the flow chart of Figure 3. Assuming the consumer has just obtained an access code from the Utility as described with reference to Figure 1, the access code will be detected at step S1 by the meter controller 9 when input by the consumer via the keypad 4. The controller 9 then decodes the input access code by operating on the code with the reverse algorithm to that used during the code generation process. The decoding process is indicated by step S2 in Figure 3. As a result of this step, the meter controller obtains the meter reading and service code which were given by the consumer to the Utility and used to generate the access code. In step S3 the meter controller 9 compares the ID data (here the service code) with that prestored in the meter controller. If the ID does not match, the code will be rejected as invalid and an appropriate message may be displayed on the display 10, where provided, as indicated by step S4 in Figure 3. The meter controller 9 then awaits input of a further access code. Assuming the

ID is determined to be correct at step S3, the controller 9 then determines at step S5 whether the meter reading decoded from the input access code is within a predetermined tolerance, for example ± 10 kWh, of the current meter reading of the meter 1. (The tolerance allowed here will of course depend on the particular consumer/Utility communication system employed, and may be varied as required for a given system). If the decoded meter reading is not correct (within the allowed tolerance), then the access code is rejected as invalid and a suitable message may be displayed at step S4 as previously described. If the meter reading is determined to be correct at step S5, then the code is determined to be valid and the meter controller 9 resets the timer 12 at step S6. Thus, if the supply had previously been cut off by closure of the valve 11, the valve 11 will be opened to restore the supply. If the valve 11 was already open (because payment was made before expiry of the three month period), then the valve 11 will remain open and the supply will be maintained for a further three month period. Where a display 10 is provided, a message may be displayed to the consumer at step S7 to acknowledge entry of the access code as confirmation to the consumer that the code has been accepted.

It will be seen from the above that the meter 1 will only allow continued gas consumption if the access code confirms that the correct meter reading was supplied to the Utility. Accuracy of the meter reading is confirmed by comparison with the current meter reading, and the coding confirms that the meter reading has been processed by the Utility. If the consumer gives an incorrect reading, intentionally or otherwise, the meter will reject the access code and the supply will be disconnected.

It will be appreciated that the system of Figures 1 and 2 can also be used to initiate gas supply to a new customer who takes over at a premises where the supply has been cut-off. (Indeed, although the supply limitation imposed here by the timer circuit is clearly advantageous, this could be omitted if the code issuing process is to be used only for reconnection of a lapsed supply). Here, the customer notifies the Utility that he wishes to open an account and supplies the service code and meter reading as indicated in Figure 1. If the system is to be operated on a prepayment basis, then payment may also be made at this stage. The new customer details are logged by the Utility, and

the subsequent operation is as already described. Again, the system could be fully automated at the Utility control station, though the customer's call could be routed to an operator if desired to obtain the new customer's details.

It will be appreciated that many variations and modifications may be made to the embodiment described above. For example, while the timer & valve control circuit 12 is indicated separately of the meter controller 9 in Figure 2 for ease of explanation, the function of the circuit 12 may of course be implemented by the controller 9 itself. Further, while the access code in this example is a function of the meter ID (service code) and meter reading, further data, which may or may not be supplied by the consumer when making payment, may be used to formulate the code. As one example, which may be particularly useful where the consumer pays in advance based on estimated consumption over a period of time, the consumption period provided by the timer 12 may be selectable from a number of options, eg one month, three months, six months etc. In this case, time periods set in the timer 12 may be variable under control of the meter controller 9. The time period selected by the consumer may be included in the access code and identified by the meter controller 9 which then sets the operating period of the timer 12 accordingly. Further, in some embodiments it may be convenient to provide the keypad 4 and an additional meter reading display 2, together with appropriate control circuitry, in a separate customer panel for mounting at convenient location inside the consumer's premises. In this case, communication between the meter control circuitry and customer panel can be effected by any convenient means.

The embodiment described above operates to ensure that the Utility obtains correct meter readings from new or existing customers while limiting the Utility's risk in gas supply to the period enabled by the timer. Figure 4 illustrates a further embodiment of metering apparatus in which the quantity of gas supplied to the consumer can also be limited, and which can also implement an authenticated termination of service function.

In the meter 14 of Figure 4, a microprocessor-based meter controller 15 is again connected to the measurement circuitry 8, meter reading display 2, keypad 4 and display 10 as already described with

reference to Figure 2. Here, however, the meter controller 15 is connected directly to the valve 11 as well as to a supply limiter circuit 16. The supply limiter circuit 16 is operable to close the valve 11 when either a preset time period has expired or a preset quantity of gas has been consumed. Thus, in addition to a timer for timing the preset supply period, the limiter circuit 16 includes means for monitoring the quantity of gas consumed since the last code to enable (or maintain) the supply was received by the meter controller 15. The quantity monitoring can be performed in a number of ways, but could be implemented, for example, by a counter which is incremented via the meter controller 15 with each measurement pulse output by the measurement circuit 8. When the count reaches a preset value indicative of consumption of a preset quantity of gas, the limiter circuit 16 outputs a control signal to close the valve 11. Similarly, on expiry of the time period preset in the timer, the limiter circuit 16 generates the control signal to close the valve. Thus, the valve will be closed to disable the supply when either the preset period has expired, or a preset quantity of gas has been consumed, whichever occurs first. In this way, the supply will be cut off before expiry of the preset time period if consumption is particularly high. The preset time and quantity limits can be set as desired for particular circumstances (and may be variable in operation as discussed further below), but typical values might be 8 million seconds and 2000 kWh respectively. When the supply limiter circuit 16 is reset as described further below, the circuit 16 outputs a control signal to open the valve 11. (If the valve is already open at this time, the open condition is unaffected by the control signal). When the circuit is reset, both the timer and counter are reset so that the timing and quantity monitoring operations begin again as of the reset time.

In this embodiment, the meter controller 15 is responsive to two (at least) different types of input code, namely a supply enable code and a supply disable code. Here, therefore, input codes issued to the consumer include instruction data identifying whether the code is an enable code or a disable code, and the meter controller 15 identifies the code type from the instruction data. Supply enable codes are used to restore a disabled supply, or maintain the supply beyond a normal cut-off point. Supply disable codes are used for authenticated

termination of service. The operation of the meter 14 in response to these input codes will now be described with reference to Figure 5, dealing first with the supply enable code.

As indicated above, a supply enable code is issued by the Utility to a consumer who wishes to restore a disabled supply or maintain a current supply beyond a normal cut-off point. The code issuing process is therefore substantially as described with reference to Figure 1, except that the code generated by the Utility incorporates instruction data for the meter to identify the code as an enable code. The code is input to the meter via the keypad 4 and detected by the meter controller 15 at step S10 in Figure 5. The meter controller 15 decodes the input code at step S11 in accordance with the prestored algorithm. As a result of this step, the meter controller 15 obtains the meter reading and service code which were supplied by the consumer to the Utility and used to generate the code, together with the instruction data identifying the code type. At step S12 the meter controller identifies the code as an enable code from the instruction data and then, at step S13, checks whether the code is valid. This step corresponds to steps S3 and S5 of Figure 3, and thus involves checking the ID data (here the service code) against the prestored code, and checking that the decoded meter reading is within the allowed tolerance of the current meter reading. If the code fails either of these tests, then the code is rejected as invalid and an appropriate message is displayed on the display 10 at step S15. Assuming that the service code is correct and the meter reading is within the allowed tolerance, the code is determined to be a valid enable code, and the meter controller then resets the supply limiter circuit 16 at step S14. This resets the timer and quantity counter of the limiter circuit which thus generates a control signal to open the valve 11. Thus, if the supply had previously been disabled by closure of the valve 11, the valve 11 will be opened to restore the supply. If the valve 11 was already open (because payment was made within the preset time period and before consumption of the preset quantity of gas) then the valve 11 will remain open and the supply will be maintained until either the preset time period has expired or the preset quantity of gas consumed. When the limiter circuit is reset at step S14, a message is displayed on the display 10 at step S15 to confirm acceptance of the enable code.

Supply disable codes are issued to a consumer who wishes to close an account, eg. on leaving a premises. Again, the code issuing process is substantially as shown in Figure 1, the customer supplying the service code and meter reading and effecting payment for consumption to-date. In this case, however, the code issued to the consumer includes instruction data identifying the code as a supply disable code, and the consumer is informed that he must report back the meter's response to input of the disable code as described further below.

When the disable code is input to the meter 14, the code is detected and decoded by the meter controller 15 at steps S10 and S11 in Figure 5, and identified as a disable code from the instruction data in step S16. (If at step S16 the code is not confirmed as a disable code, which could occur, for example, if a code was incorrectly entered by the consumer, then a suitable message is displayed on the display 10 at step S15). After identifying the disable code at step S16, at step S17, the meter controller determines whether the disable code is valid by checking the service code against the prestored service code and checking whether the decoded meter reading is within the predetermined tolerance. (If desired, the tolerance allowed here for termination of service might be less than that allowed at step S13 when enabling the service to ensure that the customer's account is fully up-to-date). If either the service code or decoded meter reading do not satisfy the necessary condition, the code is rejected as invalid and a suitable message is displayed on the display 10 at step S15.

If the disable code is validated at step S17, then the meter controller 15 generates a control signal to close the valve 11 at step S18. At step S19, the meter generates a response code which is then displayed to the consumer on the display 10 at step S15. The response code in this embodiment is generated from the service code and meter reading which were decoded from the input disable code, and is generated using a prestored algorithm which is confidential to the Utility. Other data may of course be used to generate the response code, but the code is preferably specific to the particular meter 14 at that particular time, and formulated using data already known to the Utility. This is conveniently achieved by using the ID data and meter reading decoded from the input code. To terminate responsibility for consumption at the metering point, the consumer must report the

response code displayed at step S15 back to the Utility. The Utility can then confirm that the response code is correct, by comparison with the expected response code for example. A correct response code confirms that the meter has disabled the supply and that the meter reading given by the customer was correct. The customer's account can then be closed. If the Utility does not receive the expected response code, then the account is not closed and the customer remains responsible for consumption at that metering point.

As before, in the embodiment of Figure 4 the interaction with the consumer may be automated at the Utility side by limiting the communications to selection of options and voice instructions to which the consumer replies with short strings of letters/numbers etc. However, it may be desirable in some cases, for example for opening or closing an account, for the system to connect the consumer to an operator. In particular, on closing an account the consumer may be connected to an operator who notes the consumer's telephone number and then calls back a few minutes later to obtain the response code.

The embodiment of Figures 4 and 5 may be modified in a number of ways. For example, the timer or quantity counter may be omitted from the supply limiter circuit 16 so that supply is limited to a preset quantity of gas or a preset time period only. The functions of the supply limiter circuit 16 may of course be implemented by the meter controller 15. The various modifications to the system of Figure 2 described above may also be applied to the meter 14, and in particular the preset time period and/or preset quantity in the limiter circuit 16 may be variable at the Utility's discretion and/or at the customer's selection. In some embodiments, of course, the code issuing process could be used for authenticated termination of service only in which case the supply limiter circuit could be omitted, though clearly some form of supply limitation is preferable. In addition, the meter controller 15 may be adapted to display diagnostic or status information on the display 10, for example as a code indicating the nature of a fault in the system. The consumer can then report the code to the Utility which can determine the nature of the fault from the code and take the appropriate action. In some embodiments, such action might be to issue the consumer with an appropriate "retrieval code" which can be input to the meter controller via the keypad 4 to reset

system parameters and restore normal operation. Code input and display might also be used for diagnostic and test purposes by system engineers. It will of course be appreciated that many other variations and modifications may be made to the specific embodiments described above without departing from the scope of the invention.

CLAIMS

1. Metering apparatus comprising:

means for metering the supply of a service to a consumer;

an indicator for indicating the meter reading;

valve means for selectively enabling and disabling the supply of the service to the consumer;

input means for input by the consumer of a code comprising a coded meter reading; and

control means for decoding the meter reading from an input code and controlling operation of the valve means in dependence on whether the decoded meter reading is within a predetermined tolerance of the current meter reading of the apparatus.

2. Apparatus as claimed in claim 1 wherein the control means is arranged to identify an input code as a valid enable code in dependence on whether the decoded meter reading is within said predetermined tolerance.

3. Apparatus as claimed in claim 2 wherein, in response to a valid enable code when the supply is disabled, the control means controls the valve means to enable the supply.

4. Apparatus as claimed in claim 2 or claim 3 wherein the control means includes timer means for controlling the valve means to disable the supply on expiry of a preset period of time.

5. Apparatus as claimed in claim 4 wherein, in response to a valid enable code, the timer means is reset to restore or maintain the supply for said preset period.

6. Apparatus as claimed in claim 2 or claim 3 wherein the control means is arranged to monitor the quantity of the service supplied to the consumer following receipt of a valid enable code, and to control the valve means to disable the supply when a preset quantity of the service has been supplied.

7. Apparatus as claimed in claim 5 and claim 6 wherein the control means controls the valve to disable the supply on whichever occurs first of expiry of said preset period and supply of said preset quantity.

8. Apparatus as claimed in any preceding claim wherein the control means is arranged to identify an input code as a valid disable code in dependence on whether the decoded meter reading is within said predetermined tolerance.

9. Apparatus as claimed in claim 8 wherein, in response to a valid disable code when the supply is enabled, the control means controls the valve to disable the supply.

10. Apparatus as claimed in claim 9 wherein the control means includes means for generating a response code on disabling the supply in response to a valid disable code, the apparatus including means for indicating the response code to the consumer.

11. Apparatus as claimed in any one of claim 2 to 10 wherein the input code includes additional data, the control means being arranged to decode said additional data from the input code and to identify the input code as a valid code in dependence on said additional data as well as the decoded meter reading.

12. Apparatus as claimed in claim 11 wherein the additional data comprises ID data, the control means being arranged to compare the ID data decoded from an input code with prestored ID data identifying the metering apparatus.

13. Apparatus as claimed in claim 11 or claim 12 when dependent on claim 2 and claim 8 wherein the additional data comprises instruction data, the control means being arranged to identify an input code as an enable code or a disable code from said instruction data.

14. Apparatus as claimed in any preceding claim wherein the actual meter reading data is in coded form in an input code, and the control

means is arranged to decode the coded meter reading.

15. Apparatus as claimed in claim 11 and claim 14 wherein the additional data is in coded form in an input code, and the control means is arranged to decode the coded additional data.

16. Metering apparatus substantially as hereinbefore described with reference to the accompanying drawings.

17. A metering system comprising metering apparatus as claimed in any preceding claim, and an automatic control station, the control station comprising: communication means for communicating with a consumer to prompt the consumer to communicate required data including a meter reading; and means for generating a code, comprising the communicated meter reading, for communication to the consumer by said communication means.

18. A metering system as claimed in claim 17 wherein said communication means is arranged for communication with the consumer via a telephone link and includes a voice output means for generating voice instructions to the consumer.

19. A metering system substantially as hereinbefore described with reference to the accompanying drawings.

20. A method of controlling the supply of a metered service to a consumer, the method comprising:

metering the supply by means of metering apparatus including an indicator for indicating the meter reading, valve means for selectively enabling and disabling the supply of the service to the consumer, and input means for input by the consumer of a code comprising a coded meter reading;

decoding the meter reading from an input code in the metering apparatus; and

controlling the valve means in dependence on whether the decoded meter reading is within a predetermined tolerance of the current meter reading of the apparatus.

21. A method as claimed in claim 20 including generating said code at a control station using a meter reading communicated by the consumer, and communicating the code to the consumer for input to the metering apparatus.

22. A method as claimed in claim 21 wherein the communication with the consumer by the control station is effected automatically.

23. A method as claimed in claim 21 or claim 22 wherein the communications between the consumer and control station are effected via a telephone link.

24. A method of controlling the supply of a metered service to a consumer, which method is substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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Claims searched: All **Date of search:** 19 July 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4V (VAK VMA VMB VMH VMJ VMX)

Int Cl (Ed.6): G07F 7/00

Other: ONLINE: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0420466 A1	(SPESCOM) Whole document	
A	EP 0371451 A2	(SECURE-TIME INC) See especially Column 8 Lines 5 to 20	
A	US 5258906	(KROLL) See especially Column 6 Lines 1 to 12	

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